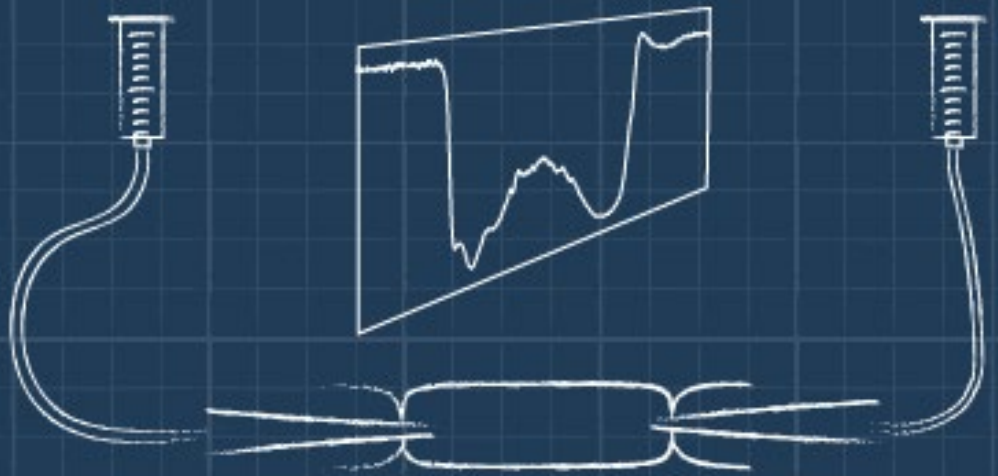


# VASOTRACKER 2.0

PRESSURE MYOGRAPHY  
BUT BETTER

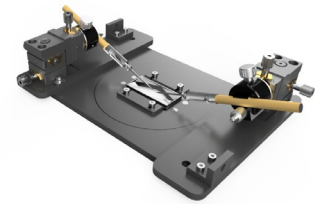


if TEMP < 37:  
set\_heater(ON)

P1 = 85 mmHg  
P2 = 75 mmHg

## VasoTracker System Guide

2024



Developed by Calum Wilson & Matthew Lee at the University of Strathclyde

Email [vasotracker@gmail.com](mailto:vasotracker@gmail.com) if you need help.

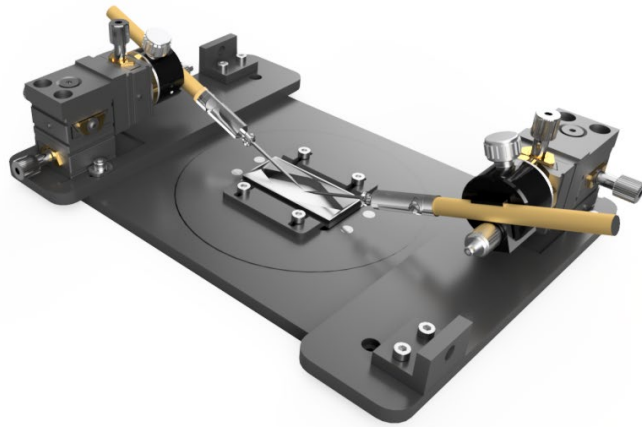
# Table of Contents

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<b>Table of Contents</b> .....	<b>1</b>
<b>Overview</b> .....	<b>2</b>
Affordable, Open-Source Pressure Myography	
Core VasoTracker Components	
Citing VasoTracker	
<b>Recommended Microscopes</b> .....	<b>4</b>
Inexpensive Microscope Options:	
New Microscope Recommendations:	
<b>Recommended Cameras</b> .....	<b>6</b>
Inexpensive Camera Options:	
New Camera Recommendations:	
<b>Recommended Computers</b> .....	<b>8</b>
Recommended Desktop Specifications	
Recommended Laptop Specifications	
<b>Temperature Control Options</b> .....	<b>10</b>
Temperature Monitoring	
Temperature Control	
Solution Control	
<b>Pressure Control Options</b> .....	<b>12</b>
Pressure Monitoring	
Pressure Regulation Options	

# Overview

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## Affordable, Open-Source Pressure Myography

**VasoTracker 2.0** is a cost-effective, open-source system designed to measure and track the diameter of isolated, pressurized blood vessels. This accessible alternative to commercial pressure myography systems costs approximately **£13,500**, roughly **25% of the cost** of commercial options.

Whether you're new to vascular research or seeking to optimize your lab's setup, VasoTracker 2.0 provides a modular and customizable solution. This guide provides an overview of core and additional components, alongside recommendations, to help you create a complete pressure myography system.

### Core VasoTracker Components

Approximate build cost: £3320

- **Bath Chamber (~£2,500)**
  - <https://vasotracker.com/pressure-myograph/>
- **Temperature & Pressure Monitor (~£320)**
  - <https://vasotracker.com/temperature-pressure-sensor/>
- **VasoMoto Pressure Control System (~£500)**
  - <https://vasotracker.com/vasomoto/>
- **VasoTracker Software (free)**
  - <https://vasotracker.com/software/>

***Additional Components for a Complete System (approximate cost for new components: £10,150)***

To fully set up a VasoTracker-based pressure myography system, the following are also required. Approximate cost for new components: £10,150.

- **Microscope** (inverted preferred, ~£5000)
- **Camera** (compatible with microscope, ~£400)
- **Laptop Computer** (for data capture and analysis, ~£500)
- **Temperature control system** (~£4250)

For more information on building your own VasoTracker system, visit <https://vasotracker.com/>.

### Citing VasoTracker

For citation details, please visit: <https://vasotracker.com/publications/>

## Recommended Microscopes

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The VasoTracker pressure myography chamber offers flexibility for researchers, being compatible with both inverted and upright microscopes. We suggest an **inverted trinocular microscope** with a camera port for optimal use.

## Inexpensive Microscope Options:

Most microscopes will work, and many researchers will be able to find a suitable microscope lying around in their department. A good source of inexpensive second-hand microscopes is eBay (**we have purchased Olympus CK40 and CKX41 microscopes for less than £1000 each**).

## New Microscope Recommendations:

At Strathclyde, we like Nikon microscopes, so here are two models that fit different budgets:

### 1. Nikon Ts2R (Price ~ £8,000)

- **Requirements:**
  - Camera port & c-mount adapter
  - Objectives (4x, 10x, 20x, 40x).
- **Benefits:**
  - This microscope has a very nice mechanical stage.
  - Nice optics.
  - Can be configured in any way you want (fluorescence options)



<https://www.microscope.healthcare.nikon.com/products/inverted-microscopes/eclipse-ts2r>

### 2. Nikon Ts2 (Price ~ £4,000)

- **Requirements:**
  - Camera port & c-mount adapter
  - Objectives (4x, 10x, 20x, 40x).
- **Benefits:**
  - Cheap
  - Nice optics
- **Drawbacks:**
  - The stage! We remove it, and just sit the myograph on directly on the microscope. This is a pain if you want fine control of where the artery is.



<https://www.microscope.healthcare.nikon.com/products/inverted-microscopes/eclipse-ts2>

## Recommended Cameras

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The VasoTracker pressure myography software is powered by Python 3 and  $\mu$ Manager 2.0. This combination facilitates lots of different camera compatibility.

## Inexpensive Camera Options:

Most microscopes will work, and many researchers will be able to find a suitable microscope lying around in their department. A good source of inexpensive second-hand microscopes is eBay (**we have purchased Olympus CK40 and CKX41 microscopes for less than £1000 each**).

## New Camera Recommendations:

We have fully tested and use the following cameras:

### 1. Thorlabs CS165MU/M (Price ~ £400)

- **Requirements:**

- Camera (~£380)
- C-mount adapter (~£18)

**Camera:** <https://www.thorlabs.com/thorproduct.cfm?partnumber=CS165MU/M>

**C-mount adapter:** <https://www.thorlabs.com/thorproduct.cfm?partnumber=SM1A10>



### 2. Basler Ace 2 (a2A1920-160um)

- **Requirements:**

- Camera (~£380)
- USB 3.0 Cable (~£6)

**Camera:** <https://www.baslerweb.com/en/shop/a2a1920-160umbas>

**USB 3.0 Cable:** <https://www.amazon.co.uk/dp/B0CQCNTLZM/>



### 3. The Imaging Source (DMK 42AUC03, Monochrome)

- **Requirements:**

- Camera (~£200)
- USB 3.0 Cable (~£6)

**Camera:** <https://www.theimagingsource.com/en-us/product/industrial/2u/dmk42auc03/>

**USB 3.0 Cable:** <https://www.amazon.co.uk/dp/B0CQCNTLZM/>





# Recommended Computers

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For optimal performance when running the VasoTracker system, we recommend a desktop or laptop with the following specifications:

## Recommended Desktop Specifications

- **Operating System:** Windows 10 or newer
- **Memory (RAM):** 16 GB minimum
- **Storage:** SSD (Solid State Drive) for efficient data handling
- **Processor:** Intel i5 or higher for robust performance

An HP desktop with these specifications generally costs around **£700**. Desktop setups can be particularly advantageous in lab environments, offering reliable integration with peripherals and long-term stability for intensive data processing.

### Example desktop computer:

HP Pro Mini 400 G9 Business Desktop - Core™ i5

- **Link:** <https://www.hp.com/gb-en/shop/product.aspx?id=997S0ET&opt=ABU&sel=DTP>
- **Cost:** £710

## Recommended Laptop Specifications

- **Operating System:** Windows 10 or newer
- **Memory (RAM):** 16 GB minimum for smooth data processing and analysis
- **Storage:** SSD (Solid State Drive) to ensure faster boot times and efficient data handling
- **Processor:** Intel i5 or higher for adequate processing power

A HP laptop with these specifications typically costs around **£1000+**. We really do recommend a desktop option though.

### Example laptop computer:

HP EliteBook 840 G11 14" Business Laptop – Core™ Ultra 7

- **Link:** [https://www.hp.com/gb-en/shop/product.aspx?id=8A4U3EA&opt=ABU&sel=NTB&\\_gl=1](https://www.hp.com/gb-en/shop/product.aspx?id=8A4U3EA&opt=ABU&sel=NTB&_gl=1)
- **Cost:** £1320

## Temperature Control Options

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## Temperature Monitoring

The **VasoTracker Temperature & Pressure Monitor** provides real-time temperature monitoring within the bath chamber. A sensor placed in the bath chamber connects to VasoTracker 2.0 software, offering continuous temperature data for precise control. The device can be built for ~£320.

**Full build details here:** <https://vasotracker.com/temperature-pressure-sensor/>

## Temperature Control

To regulate temperature, VasoTracker 2.0 relies on external temperature control systems. Here are some recommended setups with estimated costs as of October 2024:

### 1. Hotplate Stirrer & Peristaltic Pump (~£3500):

- [Hotplate Stirrer](#) (~£500)
- [2-channel Masterflex Ismatec Reglo Peristaltic Pump](#) (~£3000)

### 2. Heated Circulator & Peristaltic Pump (~£4250)

- [Optima T100 Heated Circulating Bath](#) (~£1000)
- [Radnoti Heating Coil \(1.5 mL\)](#) (~£250)
- [2-channel Masterflex Ismatec Reglo Peristaltic Pump](#) (~£3000)

### 3. Inline Solution Heater & Peristaltic Pump (~£5500)

- [Warner SH-27B inline solution heater & TC-324C Controller](#) (~£2500)
- [2-channel Masterflex Ismatec Reglo Peristaltic Pump](#) (~£3000)
- 

## Solution Control

To maintain a constant solution volume in the bath, it is recommended to use a **2-channel peristaltic pump**.

### Adjusting the Bath Volume:

- The VasoTracker 2.0 chamber offers two bath configurations:
  - **Low-volume chamber:** 2 mL capacity
  - **Higher-volume chamber:** 3.5 mL capacity
- Adjust bath volume by raising or lowering the perfusion plumbing.



**Tip:** Using larger tubing on the outflow side helps prevent overflow if both channels of the peristaltic pump are set to the same speed.

## Pressure Control Options

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## Pressure Monitoring

The **VasoTracker Temperature & Pressure Monitor** provides real-time pressure monitoring via two inline pressure transducers connected to the VasoTracker bath chamber. The device continuously streams pressure data to the VasoTracker software. The device can be built for ~£320.

**Full build details here:** <https://vasotracker.com/temperature-pressure-sensor/>

## Pressure Regulation Options

VasoTracker 2.0 supports two main types of pressure regulation systems (estimated costs as of October 2024):

### *Hydrostatic Gravity Columns (for experiments requiring flow through the blood vessel lumen)*

#### 1. Gravity-driven perfusion system (cost ~£400):

- **Setup:** 50 ml syringes mounted on magnetic holders connected to each side of the pressure myograph.
- **Operation:**
  - Maintain constant pressure without flow by setting syringes at equal height.
  - Adjust pressure by raising or lowering the syringe height.
  - Introduce flow without changing pressure by moving syringes up/down in opposite directions.
- **Monitoring:** Pressure can be observed using the **VasoTracker Pressure Monitor**.

### *Pressure Servo Controllers (for no-flow experiments, e.g. assessing myogenic tone)*

#### 1. VasoMoto Open-source Pressure Servo Controller (cost ~£200):

- **Features:** Integrates directly with VasoTracker via USB, allowing VasoTracker software to control it (does not require the VasoTracker Pressure Monitor).
- **Full build details here:** <https://vasotracker.com/vasomoto/>

#### 2. Commercial Pressure Servo Controller Systems (e.g., Living Systems LS-PS-200. ~£4000):

- VasoTracker software can control the LS-PS-200 via the following peripherals (full instructions can be found in the VasoTracker software manual):
  - National Instruments DAQ Board (e.g. [USB-6001](#), ~£275).
  - A BNC cable (e.g. Amphenol [115101-35-M1.00](#), ~£25)
  - A BNC breakout cable (e.g. [Pomona 4969](#), ~£15)



[www.vasotracker.com](http://www.vasotracker.com)